Design Automation for Structural Engineers

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About the speaker

Tomasz Fudala

He has over 17 years of experience in the software industry and a comprehensive background and vast knowledge of structural solutions in the Autodesk portfolio. He achieved a Master of Science degree in Structural Engineering from the Cracow University of Technology, Poland.
Agenda

Design Automation for Structural Engineering

- Structural Design Dynamo Package
- Structural Analysis for Dynamo Package
- Autodesk Analytical Model Dynamo Package
- Autodesk Steel Connections Dynamo Package
Structural Design Dynamo Package
Overview

Structural Design Dynamo Package

- Supports various structural workflows in Dynamo and Revit
- Nodes are shared with example scripts to automate workflows
- Cross-industry nodes
- Compatible with Dynamo 2.6
- 70 nodes and the number is growing…
Selection

Structural Design Dynamo Package

- **Selection Nodes**
  - 6 nodes to enhance default Dynamo selection of Revit model elements
  - Filter selection by categories
  - Different types of selection
    - Pick Element,
    - Pick Elements by Rectangle
    - Pick Faces
Concrete Detailing

Structural Design Dynamo Package

- **Rebar Nodes**
  - 53 nodes to automate rebar detailing
  - Area & Path reinforcement
  - Fabric Sheet reinforcement
  - Typical Rebar Designs
  - Rebar Visibility Control

![Concrete Detailing Diagram](image)
Concrete Detailing

Structural Design Dynamo Package

- NEW Nodes
Concrete Detailing: Process

Structural Design Dynamo Package

Input Parameters ➔ Retrieve Model Data ➔ Dynamo Geometry ➔ Rebar Generation ➔ Rebar Visibility
Concrete Detailing

Structural Design Dynamo Package

- Automated process of reinforcement detailing around wall openings

One Layer

Two Layers & Top Stirrups with U-shape

Two Layers & Top Stirrups are Closed
Automated Rebar Modeling with Dynamo Player

AUTOMATED VS MANUAL

TIMESAVER
Dynamo Player

Simple way to execute Dynamo scripts in Revit

- Default directory for scripts
- Filtering visible scripts
- Viewing the status of current scripts
- Launching a script
- Providing input for scripts in Dynamo Player
- Editing a script in Dynamo
Dynamo Player

Inputs & Outputs

• Supported input types
  - Select Model Element
  - Select Model Elements
  - Categories
  - Element Types
  - File Path
  - Directory Path
  - String
  - Levels
  - Boolean
  - Number

• Outputs
  - Number Slider
  - Integer Slider
  - Views
  - Number From Feet and Inches
  - Watch nodes
Precast Concrete Detailing
Structural Design Dynamo Package

- Grout Tubes Automation
  - Get point parameters based on specified division
  - Calculate grout tube rotation angle
Frame Design

Structural Design Dynamo Package

• Frame Design Automation
  o 10 nodes to automate frame design
Frame Design

Structural Design Dynamo Package
Truss Design

Structural Design Dynamo Package

- **Truss Design Automation**
  - 4 nodes to automate frame design
- **Warren truss**
- **Special truss**
  - By boundary points
  - By two curves
  - By four curves
- **Easy of usage**
Truss Design

Structural Design Dynamo Package

- Examples
Truss Design

Structural Design Dynamo Package

• Examples
Structural Analysis for Dynamo Package
Automate structural analysis

Structural Analysis for Dynamo Package, Robot Structural Analysis Professional
Automate Structural Analysis

Structural Analysis for Dynamo Package, Robot Structural Analysis Professional
Automate Structural Analysis

Structural Analysis for Dynamo Package, Robot Structural Analysis Professional

• Create Analytical Model in Robot
  o Analytical Nodes, Lines, Surfaces
• Set Attributes: Section Shapes, Gamma Angles, Materials
• Definition of Boundary Conditions
  o Supports, Releases
• Definition of Loads
  o Load cases
  o Applying: nodal, linear and surface loads
• Running Calculation from Dynamo
• Getting results of the analysis from RSA in Dynamo
Automate Structural Analysis

Structural Analysis for Dynamo Package, Robot Structural Analysis Professional

Dynamo Geometry
Analytical Model
Set Boundary Conditions and Loads
Run Calculation
Retrieve Results
DEM0
Automate Structural Analysis

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- Dynamo in Robot
Automate Structural Analysis

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- Join beta
  - [https://feedback.autodesk.com/key/RSA_Feedback](https://feedback.autodesk.com/key/RSA_Feedback)
Autodesk Analytical Model
Dynamo Package
Automation of Analytical Model Adjustment

Autodesk Analytical Model 2021 Dynamo Package, Autodesk Revit 2021

- Adjust Elements Between Categories
- Adjust Elements Within Categories
- Works with Dynamo 2.6 and Revit 2021
Automation of Steel Connections

Autodesk Steel Connections Dynamo Package, Autodesk Revit 2020

- **Steel Connections for Dynamo**
  - New Dynamo nodes to model steel connections
  - Out-of-the-box scripts ready to be run in Dynamo Player
Automation of Steel Connections

Autodesk Steel Connections Dynamo Package, Autodesk Revit 2020.2

- Nodes for Steel Connections that Read Analysis Results
  - Read analysis results for load cases, combinations and envelopes
  - Analysis results are used to drive automatic connection placement
  - Faster design iteration
Automation of Steel Connections

Autodesk Steel Connections Dynamo Package, Autodesk Revit 2020.2

- Nodes that Load Steel Connections from Libraries
  - Save libraries of connections as Revit project files
  - New nodes for rule-based loading of connections from libraries
  - Automatically load the required pre-configured connection types
Automation of Steel Connections
Autodesk Revit 2021

- Integrated Steel Connection Automation Nodes in Dynamo for Revit 2021
  - Nodes available in Dynamo for Revit
  - Thumbnail pictures for all nodes
  - Sample scripts available
Conclusions

Automation of Structural Design with Dynamo

• Making your own design tools is easy
• Build optimized structures with minimal energy
• Work faster with complex structures
• Automated processes save tones of manual and tedious work, save a lot of time
• Dynamo opens a world of possibilities for all structural personas